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Abstract

THE POSSIBLE UTILISATION OF NUCLEAR REACTORS FOR SEA WATER DISTILLATION IN ISRAEL

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After about ten years of water resources development on a national scale, Israel is approaching the stage where about 90% of the total water available - 1,500 to 1,700 million m^3 per year - will be in use. (The present water demand is about 1,200 million m^3 per year). Also, part of the water available has a salt content exceeding the amount admissible for agriculture.

Continued development of Israel, a typical area of water scarcity, depends on new water sources, the biggest part of which could come only from desalination of sea water.

It is estimated that up to 200 million m^3 per year (about 600,000 m^3 /day or 160 million G.P.D.) of converted sea water will be needed within the next ten years.

Three different types of desalination plants are in operation or being constructed in Israel;- using the distillation process, the freezing principle and electrodialysis. The planning of the sea-water conversion plants is directed by a Government-sponsored Sea Water Conversion Committee. A dual-purpose plant at Eilat, comprising a 6,700 kw back-pressure turbogenerator, the exhaust steam of which will be used to operate two 30-stage flash evaporator units, each producing 160 m^3 /h (3,800 m^3 or 1 million gallons water per day), is scheduled to start operation by the end of 1964. Also at Eilat, the locally developed Zarhin freezing process is used in a pilot plant of four units with a total capacity of 40 m^3 /h or 1,000 m^3 /water per day (250,000 G.P.D.).

Several electrodialysis pilot plants for the desalination of brackish water

with a capacity of up to $20 \text{ m}^3/\text{h}$ (125,000 G.P.D.) are also in operation or being built.

The most economical solution for sea water conversion seems to be to build future electricity generation units as dual-purpose plants, similar to, but of much higher capacity than, the Eilat plant, corresponding to the amount of extension required for existing power stations. The feasibility of nuclear steam generation for these extensions is under investigation.

The present total installed capacity of the power grid in Israel is 720 Mwe, the doubling period of the electricity demand being five to six years. The biggest generating units now under construction have a capacity of 125 Mwe.

The exhaust steam of a back pressure turbogenerator of 125 Mwe, if using the same high pressure steam conditions (140 atm. g., 530°C) as 125 Mwe condensing units, would be sufficient for heating up to four flash evaporator units, each of $22,500 \text{ m}^3/\text{day}$ (6 million G.P.D.) capacity. These are the largest flash evaporator units available commercially to date. They will have a performance ratio (kg of distilled water per kg of heating steam) of approximately 12, with heating of the sea water (limited by scaling risk) to 110°C (230°F). The Eilat 30-stage flash evaporators will have a performance ratio of 8 and a maximum sea water temperature of 94°C (200°F).

If further developments in large flash evaporators make it possible to heat the sea water up to 135°C (275°F), or possibly even to 150°C (300°F), it may be economical to generate the evaporator-heating steam directly, without passing it through a back-pressure turbine.

Under an IAEA research contract, dual-purpose nuclear reactors for power and desalination purposes and process heat reactors for low pressure steam generation for desalination only will be compared technically and economically with conventional steam generation in Israel.

On the basis of different electricity credit and capital cost estimations, the costs per cubic metre of distilled water are calculated. Investment costs based on these alternatives and the water prices expected are given in tabular and diagrammatic form.